

Gas-Phase Sensors

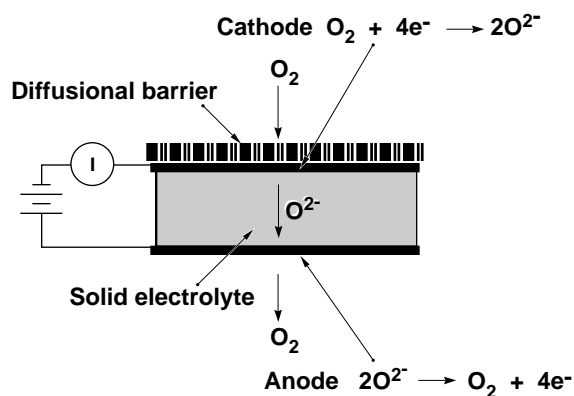
Advanced solid-state sensors for real-time monitoring and analysis

Solid-state sensors are needed to monitor gaseous species such as O_2 , NO_x , CO , H_2 , SO_2 , and hydrocarbons. One important application is monitoring automobile emissions. Future automobiles will operate in the “lean burn” regime and will need new types of oxygen sensors for the exhaust system. To that end, we are developing a solid-state amperometric sensor to be used in feedback control systems that will decrease emissions and improve engine performance.

Sensor operation

The accompanying figure shows the operation of an amperometric sensor. The measured current flowing in the circuit is proportional to the oxygen concentration in the exhaust stream. These sensors are extremely sensitive and can monitor part-per-million and sub-part-per-million concentrations.

We are testing several electrolytes (ionic conductors for the oxygen ion), notably CeO_2 , for low-temperature operation. In addition, we are developing diffusion barriers—aerogels, xerogels, and perovskites—that can be applied to the sensor surface to establish linear response in the appropriate oxygen concentrations.



Ion conduction through an amperometric oxygen sensor.

Multiple species sensors

We are also developing semiconducting oxide sensors for other gaseous species. We would fabricate these sensors using planar, thin-film technology, state-of-the-art materials deposition, and ion beam modification. A miniature, micro-fabricated array containing several different sensors on a single chip would allow multiple species monitoring and speciation. These devices could be used to monitor both automobile and industrial emissions.

APPLICATIONS

- Emissions and feedback control systems
- Real-time gas speciation
- Environmental monitoring

Materials characterization

Materials characterization is an important part of our work. We use impedance spectroscopy to examine the various contributions to the overall resistance of the gas sensors.

We use x-ray diffraction and surface analytical techniques to examine other structural and chemical properties.

Availability: Our unique capabilities in thin-film deposition, ion beam modification, materials characterization, and multidisciplinary interactions create an ideal environment in which to conduct research and development in this area. We welcome the participation of all industries with gas analysis and gas monitoring problems.

Contact

Robert S. Glass
 Phone: (510) 423-7140
 Fax: (510) 422-6892
 E-mail: glass3@llnl.gov
 Mail code: L-352